

What is Claimed is:

- 1 1. A fine granularity scalable encoder comprising:
  - 2 a base-layer encoding block including a coarse prediction loop, said coarse prediction
  - 3 loop having a coarse prediction output;
  - 4 an enhancement-layer encoding block including a fine prediction loop and an
  - 5 enhancement-layer mode selector, said fine prediction loop having a fine prediction
  - 6 output;
  - 7 wherein said encoder operates in a mix prediction mode when said enhancement-
  - 8 layer mode selector is switched to select said fine prediction output, and said encoder
  - 9 operates in an all-coarse prediction mode when said enhancement-layer mode selector
  - 10 is switched to select said coarse prediction output.
- 1 2. The fine granularity scalable encoder as claimed in claim 1, said base-layer encoding
  - 2 block further comprising a base-layer mode selector, wherein said encoder operates in
  - 3 an all-fine prediction mode when both said base-layer mode selector and said
  - 4 enhancement-layer mode selector are switched to select said fine prediction output,
  - 5 said encoder operates in an all-coarse prediction mode when both said base-layer
  - 6 mode selector and said enhancement-layer mode selector are switched to select said
  - 7 coarse prediction output, and said encoder operates in a mix prediction mode when
  - 8 said base-layer mode selector is switched to select said coarse prediction output and
  - 9 said enhancement-layer mode selector is switched to select said fine prediction output.
- 1 3. The fine granularity scalable encoder as claimed in claim 2, further comprising a
  - 2 mode decision unit for adaptively controlling said enhancement-layer and base-layer

3 mode selectors.

1 4. The fine granularity scalable encoder as claimed in claim 3, said mode decision unit  
2 further comprising a mismatch estimation unit for estimating mismatch errors  
3 between said said coarse prediction output and said fine prediction output.

1 5. The fine granularity scalable encoder as claimed in claim 4, further comprising a  
2 worst-case base-layer decoder for providing a worst-case coarse prediction output to  
3 said mismatch estimation unit.

1 6. A fine granularity scalable decoder comprising:

2 a base-layer decoding block including a coarse prediction loop, said coarse prediction  
3 loop having a coarse prediction output;

4 an enhancement-layer decoding block including a fine prediction loop and an  
5 enhancement-layer mode selector, said fine prediction loop having a fine prediction  
6 output;

7 wherein said decoder operates in a mix prediction mode when said enhancement-  
8 layer mode selector is switched to select said fine prediction output, and said decoder  
9 operates in an all-coarse prediction mode when said enhancement-layer mode selector  
10 is switched to select said coarse prediction output.

1 7. The fine granularity scalable decoder as claimed in claim 6, said base-layer decoding  
2 block further comprising a base-layer mode selector, wherein said decoder operates in  
3 an all-fine prediction mode when both said base-layer mode selector and said  
4 enhancement-layer mode selector are switched to select said fine prediction output,  
5 said decoder operates in an all-coarse prediction mode when both said base-layer

6 mode selector and said enhancement-layer mode selector are switched to select said  
7 coarse prediction output, and said decoder operates in a mix prediction mode when  
8 said base-layer mode selector is switched to select said coarse prediction output and  
9 said enhancement-layer mode selector is switched to select said fine prediction output.

1 8. An encoding method having at least two coding modes, said method comprising the  
2 steps of:

3 (a) collecting encoding parameters from each macroblock of a plurality of  
4 macroblocks of input signals;

5 (b) analyzing said encoding parameters to determine a coding mode for each  
6 macroblock; and

7 (c) encoding each macroblock according to the coding mode determined in said step  
8 (b).

1 9. The encoding method as claimed in claim 8, wherein said plurality of macroblocks  
2 are classified in said step (b) into at least two coding groups and each macroblock in a  
3 coding group is assigned with a same coding mode.

1 10. The encoding method as claimed in claim 8, wherein said encoding method has an  
2 all-coarse prediction mode, an all-fine prediction mode, and a mix prediction mode,  
3 and said plurality of macroblocks are classified in said step (b) into an all-coarse  
4 prediction group in which each macroblock is assigned with said all-coarse prediction  
5 mode, an all-fine prediction group in which each macroblock is assigned with said  
6 all-fine prediction mode and a mix prediction group in which each macroblock is  
7 assigned with said mix prediction mode.

- 1 11. The encoding method as claimed in claim 8, wherein said encoding method includes a  
2 base layer with coarse prediction and an enhancement layer with fine prediction, and  
3 encoding parameters collected from each macroblock in said step (a) include a fine  
4 prediction error value, a coarse prediction error value, and best-case and worst-case  
5 mismatch errors in fine prediction.
- 1 12. The encoding method as claimed in claim 11, wherein said encoding method has an  
2 all-coarse prediction mode, an all-fine prediction mode, and a mix prediction mode,  
3 and said plurality of macroblocks are classified in said step (b) into an all-coarse  
4 prediction group in which each macroblock is assigned with said all-coarse prediction  
5 mode, an all-fine prediction group in which each macroblock is assigned with said  
6 all-fine prediction mode and a mix prediction group in which each macroblock is  
7 assigned with said mix prediction mode.
- 1 13. The encoding method as claimed in claim 11, wherein said plurality of macroblocks  
2 are classified into at least two coding groups according to a coding gain derived from  
3 said fine and coarse prediction error values of each macroblock and a predicted  
4 mismatch error derived from said best-case and worst-case mismatch errors of each  
5 macroblock.
- 1 14. The encoding method as claimed in claim 13, wherein said encoding method has an  
2 all-coarse prediction mode, an all-fine prediction mode, and a mix prediction mode,  
3 and said plurality of macroblocks are classified in said step (b) into an all-coarse  
4 prediction group in which each macroblock is assigned with said all-coarse prediction  
5 mode, an all-fine prediction group in which each macroblock is assigned with said  
6 all-fine prediction mode and a mix prediction group in which each macroblock is

7 assigned with said mix prediction mode.

1 15. The encoding method as claimed in claim 14, wherein the coding gain of a given  
2 macroblock divided by the predicted mismatch error of the given macroblock is  
3 defined as the coding efficiency of the given macroblock, and the given macroblock  
4 is then assigned with one of said all-coarse prediction mode, said all-fine prediction  
5 mode and said mix prediction mode according to the coding efficiency of the given  
6 macroblock.

1 16. The encoding method as claimed in claim 15, wherein a coding efficiency mean and  
2 a coding efficiency standard deviation are computed from the coding efficiencies of  
3 said plurality of macroblocks, and the given macroblock is assigned with one of said  
4 all-coarse prediction mode, said all-fine prediction mode and said mix prediction  
5 mode by comparing the coding efficiency of the given macroblock to values  
6 determined by said coding efficiency mean and said coding efficiency standard  
7 deviation.

1 17. The encoding method as claimed in claim 16, wherein the given macroblock is  
2 assigned with said all-coarse prediction mode if the coding efficiency of the given  
3 macroblock is smaller than the difference of said coding efficiency mean and a pre-  
4 determined multiple of said coding efficiency standard deviation, the given  
5 macroblock is assigned with said all-fine prediction mode if the coding efficiency of  
6 the given macroblock is larger than the sum of said coding efficiency mean and a pre-  
7 determined multiple of said coding efficiency standard deviation, and otherwise the  
8 given macroblock is assigned with said mix prediction mode.

1 18. A method for truncating bit-planes in an enhancement layer of a group of pictures for

2 allocating bits sent to a client channel, comprising the steps of:

3 (a) performing low-rate bit truncation if total bits available for allocation for said

4 enhancement layer are less than or equal to total number of enhancement-layer

5 bits in all I/P-frames in said group of pictures used for fine prediction;

6 (b) performing medium-rate bit truncation if total bits available for allocation for said

7 enhancement layer are less than or equal to total number of enhancement-layer

8 bits in said group of pictures used for fine prediction but greater than total number

9 of enhancement-layer bits in all I/P-frames in said group of pictures used for fine

10 prediction; and

11 (c) performing high-rate bit truncation if total bits available for allocation for said

12 enhancement layer are greater than total number of enhancement-layer bits in said

13 group of pictures used for fine prediction.

1 19. The method for truncating bit-planes in an enhancement layer of a group of pictures

2 for allocating bits sent to a client channel as claimed in claim 18, wherein said low-

3 rate bit truncation allocates each I/P-frames of said enhancement layer with a number

4 of bits proportional to a ratio of the number of bits used for prediction in each I/P-

5 frames to total number of bits used for fine prediction for all I/P-frames in said group

6 of pictures, and allocates no bit to any B-frame of said enhancement layer.

1 20. The method for truncating bit-planes in an enhancement layer of a group of pictures

2 for allocating bits sent to a client channel as claimed in claim 19, wherein said

3 medium-rate bit truncation allocates each I/P-frames of said enhancement layer with a

4 number of bits equal to the number of bits used for fine prediction in each I/P-frames,

5 and allocates each B-frame of said enhancement layer with a number of bits  
6 proportional to a ratio of the number of enhancement-layer most significant bits used  
7 for fine prediction in each B-frame to total number of enhancement-layer most  
8 significant bits used for fine prediction for all B-frames in said group of pictures.

1 21. The method for truncating bit-planes in an enhancement layer of a group of pictures  
2 for allocating bits sent to a client channel as claimed in claim 20, wherein said high-  
3 rate bit truncation allocates each I/P-frames of said enhancement layer with a number  
4 of bits equal to the number of bits used for fine prediction in each I/P frames plus a  
5 number of bits proportional to a ratio of the number of bits used for fine prediction in  
6 each I/P-frames to the summation of total number of bits used for fine prediction for  
7 all I/P-frames in said group of pictures and total number of enhancement-layer most  
8 significant bits used for fine prediction for all B-frames in said group of pictures, and  
9 allocates each B-frame of said enhancement layer with a number of bits proportional  
10 to a ratio of the number of enhancement-layer most significant bits used for fine  
11 prediction in each B-frame to the summation of total number of bits used for fine  
12 prediction for all I/P-frames in said group of pictures and total number of  
13 enhancement-layer most significant bits used for fine prediction for all B-frames in  
14 said group of pictures.

1 22. The method for truncating bit-planes in an enhancement layer of a group of pictures  
2 for allocating bits sent to a client channel as claimed in claim 21, wherein said  
3 medium-rate bit truncation allocates each I/P-frames of said enhancement layer with a  
4 number of bits equal to the number of bits used for fine prediction in each I/P-frames,  
5 and allocates each B-frame of said enhancement layer with a number of bits

6 proportional to a ratio of the number of enhancement-layer most significant bits used  
7 for fine prediction in each B-frame to total number of enhancement-layer most  
8 significant bits used for fine prediction for all B-frames in said group of pictures.

1 23. The method for truncating bit-planes in an enhancement layer of a group of pictures  
2 for allocating bits sent to a client channel as claimed in claim 18, wherein said high-  
3 rate bit truncation allocates each I/P-frames of said enhancement layer with a number  
4 of bits equal to the number of bits used for fine prediction in each I/P frames plus a  
5 number of bits proportional to a ratio of the number of bits used for fine prediction in  
6 each I/P-frames to the summation of total number of bits used for fine prediction for  
7 all I/P-frames in said group of pictures and total number of enhancement-layer most  
8 significant bits used for fine prediction for all B-frames in said group of pictures, and  
9 allocates each B-frame of said enhancement layer with a number of bits proportional  
10 to a ratio of the number of enhancement-layer most significant bits used for fine  
11 prediction in each B-frame to the summation of total number of bits used for fine  
12 prediction for all I/P-frames in said group of pictures and total number of  
13 enhancement-layer most significant bits used for fine prediction for all B-frames in  
14 said group of pictures.